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Angiographic Embolisation in Arterial Trauma

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Objectives: to evaluate the use of endovascular occlusion in the treatment of arterial trauma.

Methods: records of patients with penetrating arterial injuries treated by endovascular occlusive techniques were culled from the computerised database of the vascular service.

Results: the study period spanned 7 years. Forty-two patients were studied with injuries to the cervicofacial vessels (24), lower limb (16) and upper limb (1). 13 had an arteriovenous fistula. There were 4 failures. In 2 cannulation was not achieved and in 2 with A-VF distal vessel occlusion was impossible. Two patients developed complications. In the remainder, treatment was effective and durable.

Conclusion: this treatment modality is effective and safe in the treatment of penetrating trauma in selected patients.

Key Words: Arterial trauma; Embolotherapy.

Introduction

In the current era of complex trauma, angiography has established itself as an invaluable tool to evaluate vascular injuries. It serves both as a confirmatory diagnostic tool as well as to define anatomical location in order to plan surgical intervention. The sophistication of percutaneous instrumentation and improvement in imaging has led to the emergence of radiological intervention as a useful therapeutic option to deal with vascular compromise. Initially performed in the context of vascular disease, this has rapidly been extrapolated to trauma.¹ The techniques of stenting and embolisation are well documented.²

The role of interventional radiology, specifically embolisation of non-critical, peripheral and cervical traumatised vessels, has been reported.³ However, in the context of the increasing interest in interventional radiology in vascular disease, the specific role of interventional radiological embolisation warrants reappraisal in the management of peripheral vascular trauma.

Materials and Methods

The records of all patients who had angiographic embolisation attempted following vascular trauma

from January 1990 to June 1997 were analysed. Angiography was performed using the standard Seldinger technique with access to the arterial tree from the femoral artery. When the injured vessel was deemed to be non critical, the vessel was superselected with a 5–7-French catheter and embolisation attempted by the placement of a Gianturco spring coil (Cook) or by the injection of haemostatic thrombin (Gelfoam); this was done distal to the injury and then proximally when feasible. The procedure was deemed a failure when the injured vessel could either not be cannulated or coil placement was deemed inadequate, under which circumstances the injury was surgically treated.

Results

Of the 41 embolisations attempted, only 4 failed. In 2 patients it was not possible to cannulate the offending vessels (facial artery and the peroneal artery), and these patients had surgical ligation of the injury. In 3 patients with an arteriovenous fistula, distal coil placement was not possible, but coils were placed in the major feeding vessels. This proved successful in one patient, as it effected thrombosis that was demonstrated on repeat angiography. In the other 2 patients the fistula recurred via distal feeding vessels which required operative management.

Only 2 patients developed complications. One patient sustained a transient ischaemic attack following

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Fig. 1. Arteriovenous fistula between the vertebral artery within the bony canal (small arrow) and the internal jugular vein (large arrow) following a gunshot wound (a). Successful embolisation with a spring coil (arrow) is demonstrated in (b).

migration of the coil into the internal carotid artery during attempts to occlude the superior thyroid artery. This patient required a surgical thrombectomy and coil extraction from the internal carotid artery. The patient made an uneventful recovery, with no demonstrable neurological sequelae. The second patient had venous embolisation of the coil through an arteriovenous fistula involving the vertebral vessels, resulting in a radiological pulmonary infarct but without any clinical sequelae.

In 11 patients where embolisation was successful, evacuation of gluteal haematomas was performed to facilitate clinical recovery and eliminate the potential septic complications. No inappropriate haemorrhage occurred at this procedure.

The patients were observed for 48 hours in the vascular unit and reviewed at 2 weeks, 6 weeks, and then at 3-monthly intervals for 1 year. There were no long-term complications recorded at late follow-up. There was no mortality.

Figure 1 shows successful occlusion of an arterio-

venous fistula of the vertebral artery situated in the bony canal following a gunshot wound.

In Fig. 2 successful occlusion of a false aneurysm in the buttock arising from the superior gluteal artery is shown. This followed a stab wound several years

Table 1. Anatomic sites of arteries embolised ($n=41$).

Anatomic sites of arteries embolised ($n=41$)	
Cervicofacial ($n=24$)	
• Superior thyroid	8
• Facial	7
• Vertebral	7
• Posterior auricular	1
• Maxillary	1
Lower Limb ($n=16$)	
• Superior gluteal	10
• Profunda femoris	2
• Anterior tibial	2
• Peroneal	2
Upper Limb ($n=1$)	
• Circumflex humeral	1

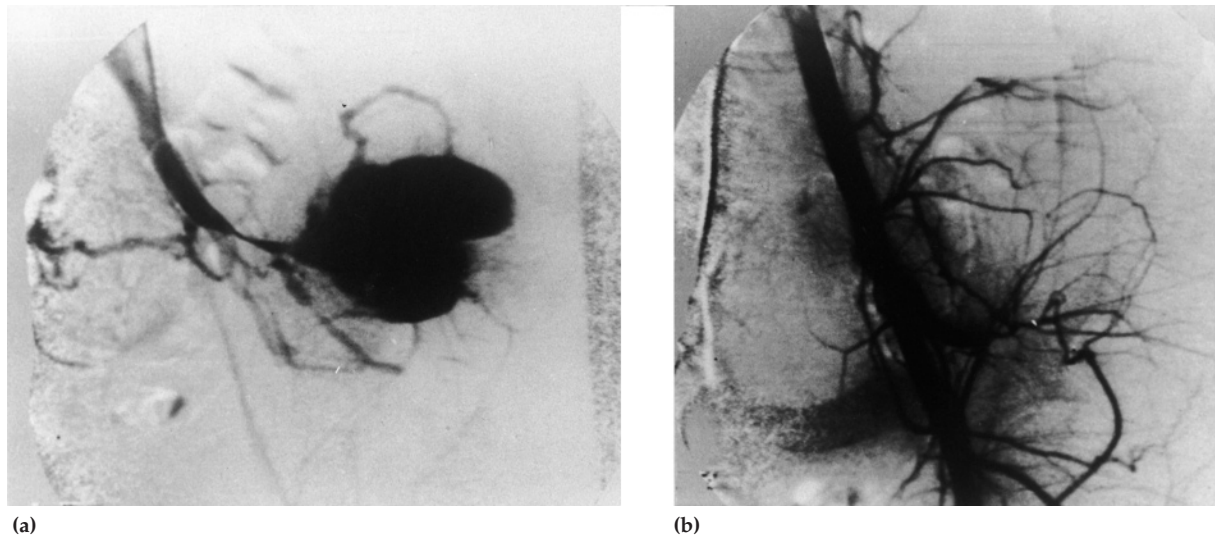


Fig. 2. Post-traumatic superior gluteal artery false aneurysm (a) following successful embolisation (b).

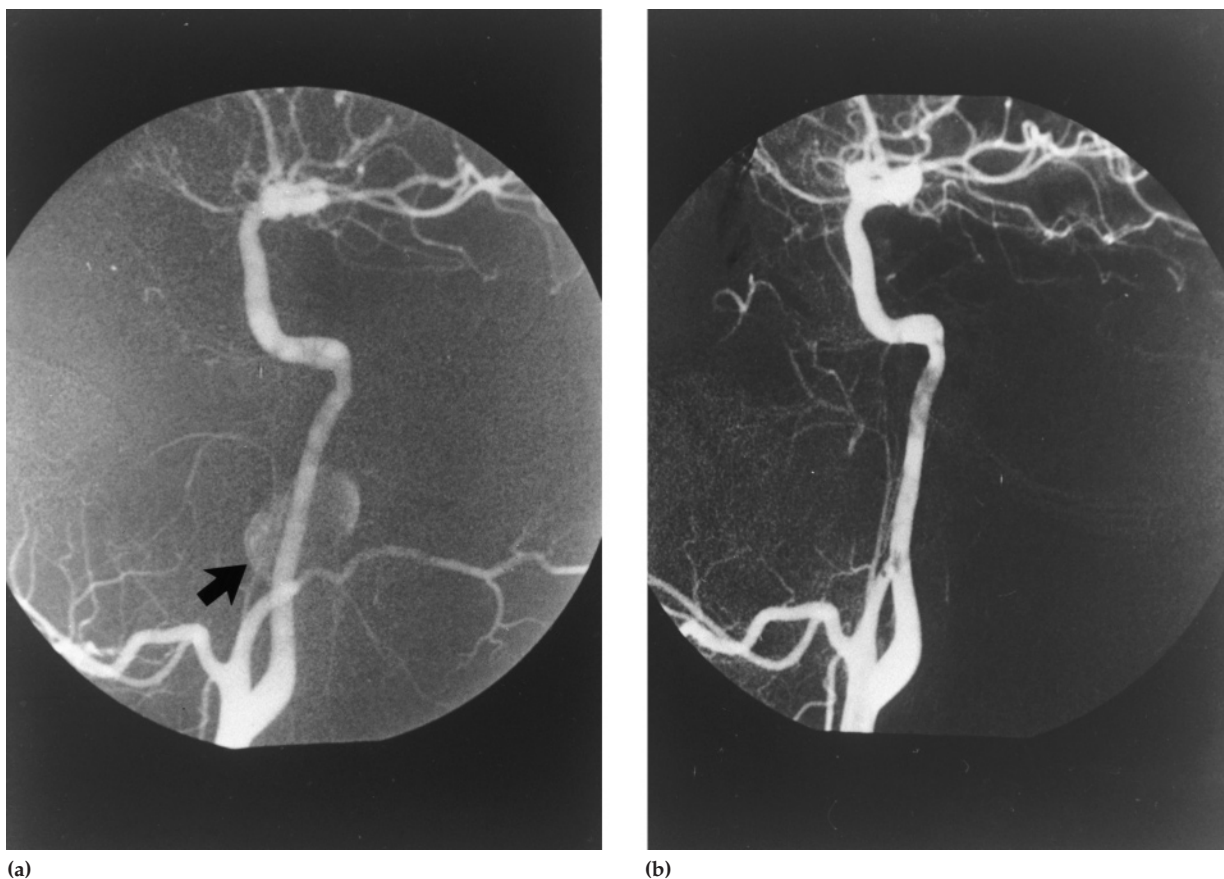


Fig. 3. False aneurysm of the external carotid artery (arrow) following a stab wound (a) and after successful embolisation (b).

earlier. The large buttock haematoma was subsequently evacuated surgically through a small incision. In Fig. 3 a false aneurysm is shown arising from the external carotid artery (a) which was successfully treated by occlusion using a spring coil (b).

Discussion

The standard policy in our unit has been to repair all critical vascular injuries and to ligate non-critical injured vessels. Against the formidable demands

imparted by vascular trauma, it has become necessary to identify alternate methods to effect therapy of these injuries. The treatment of the critical vascular injury remains surgical exploration. For the non-critical vascular injury, the advances in vascular interventional radiology have offered alternate minimally invasive procedures. To justify alternative therapeutic modalities, they must be proven to be at least as efficacious as conventional therapy.

Embolisation of non-critical vascular injuries is attractive for several reasons. It may circumvent the hazards of surgical exploration, particularly in an area where the anatomy has been distorted by the injury. It will certainly expedite patient recovery and minimise hospital management, which is attractive in the current era of cost-effective utilisation of hospital facilities. In addition, in technically demanding areas such as the head and neck, successful application of interventional techniques will obviate the need for surgical intervention and minimise the damage incurred.

Angiographic embolisation has been used extensively in clinical practice. Initially employed to manage upper gastrointestinal haemorrhage,⁴ its role was extended to neoplastic lesions to diminish vascular inflow and facilitate surgical excision.⁵

The success achieved in these areas broadened the indications to encompass arteriovenous fistulae both congenital and traumatic. This technique is best reflected in the treatment of carotid-cavernous fistulae that pose a problem of both inaccessibility and potential morbidity and mortality.⁶

The role of angiographic embolisation of penetrating, peripheral, non-visceral injuries has been sparsely reported.² This series of 41 patients that culminated in an 88% success rate attests to the efficacy of the procedure. Furthermore, failure did not compromise patient outcome, as the preamble to the exercise is mandatory in order to define the lesion and to plan the subsequent surgical strategy.

There were no deaths in this series and this is comparable with the results reported in a smaller series by McNeese *et al.*⁷ Although these authors reported zero morbidity, in the present series a 5% morbidity was experienced. Although these complications proved to be clinically trivial, it is prudent to recognise that the potential for morbidity remains. Critical analysis of the two complications encountered would suggest that certain precautions need to be observed to minimise or eliminate morbidity. Injuries in proximity to major vessels where the spring coil placement is liable to abut on the origin of the major feeding vessel are probably better managed surgically. Large arteriovenous fistulae should only be occluded

angiographically if a safe distance can be achieved between the fistula and the proximal and distal placement of the coils. When this is not feasible, surgical exploration would be deemed the safer option. Nevertheless, the merit of the procedure has certainly met with the criteria to establish its continued use as a therapeutic option in the management of vascular trauma in the patient who is haemodynamically stable. The technical limitation of access to smaller vessels has been minimised by the development of microcatheters and microcoils.⁸ This refinement has certainly impacted on the management of lesions involving intracranial and spinal vessels.^{9,10} Whilst availability has precluded its use in our centre to date, it has the potential for use in the smaller calibre vessel not accessible with the traditional catheters and coils.

There is no argument that it is as effective as surgery without the cosmetic insult of the latter. However, it should only be employed where the vessels can be safely sacrificed without any anticipated ischaemic sequelae. It should be employed with caution in injuries close to the origin of major vessels or where the pathology is a large arteriovenous fistula. It is thus prudent that the decision for angiographic embolisation be done with the consent of the attending surgeon to minimise any consequent morbidity and to pre-empt a surgical strategy should the procedure prove unsuccessful or complicated. As experience is gained, the precise guidelines to circumvent morbidity will be better-defined, with the close co-operation of the radiological and surgical disciplines.

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